(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
17 April 2003 (17.04.2003)

PCT

(10) International Publication Number
WO 03/030702 A2

(51) International Patent Classification[7]: A47L 9/00

(21) International Application Number: PCT/TR02/00064

(22) International Filing Date: 11 October 2002 (11.10.2002)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2001/02964 12 October 2001 (12.10.2001) TR
Not furnished 11 October 2002 (11.10.2002) TR

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(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG,

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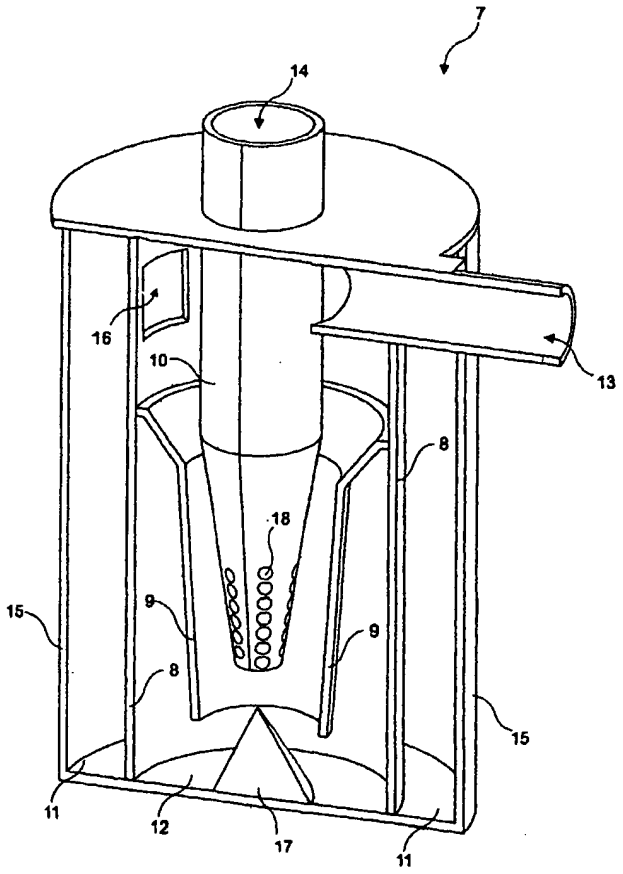
(54) Title: VACUUM CLEANER



(57) Abstract: The vacuum cleaner comprises a cyclone unit (7) that separates and extracts the dust and dirt from the sucked-in dirt laden air. Said cyclone unit (7) comprises an outer casing (15); an air inlet opening (13) located on the outer casing (15), whereby the sucked-in air enters; an air outlet (14); three cyclonic separator housings (8,9, and 10) to separate the dust borne in the sucked-in are, that air arranged in a telescopic manner, coaxially in series; and chambers (11 and 12) for receiving and collecting the separated dust particles.

WO 03/030702 A2

SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) **Designated States** *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *without international search report and to be republished upon receipt of that report*

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VACUUM CLEANER

The present invention relates to a vacuum cleaner in which cyclonic dust separators are used to perform the cleaning operation.

The cyclonic separators are the most commonly used devices for industrial separation/disintegration processes, for instance in petroleum and coal exploitation sectors due to their low costs and easy maintenance properties. The general operational principle of these separators is the separation of materials having different properties, from each other by means of the centrifugal force. They are used in the fields of separating the liquid-liquid, gas-liquid, gas-solid and solid-solid phases.

In the vacuum cleaners, by using said cyclonic separators, the requirement for using dust bags is eliminated whereby reduction in the suction efficiency of the machine due to the filling of the dust bag, are avoided. By virtue of the geometry and structure of the cyclonic separator, dust is separated from the suction air in one or more cascades. (Said cascades are used to separate the dust particles of different dimensions, from the suction air).

In EP No. 0042723, an outer cyclone of a lower efficiency (to separate larger dust particles) and a higher efficiency inner cyclone (to separate fine dust particles) are disclosed.

In the EP No 0885585, a vacuum cleaner having three cyclonic separators arranged in cascade is disclosed.

The object of the present invention is to realize a vacuum cleaner which eliminates the need for the use of a dust bag by using serially arranged cyclonic separators and which avoids reduced suction efficiency.

The vacuum cleaner realized to attain the object of the invention has been illustrated in the attached drawings wherein;

Figure 1, is the schematical view of a vacuum cleaner,

Figure 2, is the perspective view of the cyclonic separator,

Figure 3, is the cross sectional view of the cyclonic separator,

Figure 4, is the schematical view of the cyclonic separator.

Figure 5, is the schematical view of the cyclonic separator comprising a trap piece.

The components shown in the drawings have been separately given reference numerals as follows:

1. Vacuum cleaner body
2. Hose
3. Handle
4. Extension pipe
5. Cleaner head
6. Vacuum cleaner
7. Cyclone unit
8. First cyclonic separator housing
9. Second cyclonic separator housing
10. Third cyclonic separator housing
11. First dust receiving and collection chamber
12. Second dust receiving and collection chamber
13. Air inlet
14. Air outlet
15. Outer casing
16. Window
17. Air-flow directing structure
18. Hole

19. Trap piece

20. Opening

The vacuum cleaner (6) according to the present invention, comprises a vacuum cleaner body(1); a hose (2) preferably made of plastic material, connected to said housing (1); a handle (3) connected to said hose (2) to facilitate the handling of the tube by the user; and an extension pipe (4) made of metal or rigid plastic material, connected to said handle (3); a cleaner head (5) connected to the end of said pipe (4) for cleaning the rugs and/or hard ground surfaces; and a cyclone unit (7) which operates to extract dirt and dust particles from the sucked-in air-flow therethrough.

Said cyclone unit (7) comprises an outer casing(15); an air inlet opening (13) located on the outer casing (15), whereby the sucked-in air enters; an air outlet opening (14); three cyclonic separator housings (8,9, and 10) to separate the dust, borne in the sucked-in air, that are arranged in a telescopic manner, coaxially in series; and chambers (11 and 12) for receiving and collecting the separated dust particles.

The outer casing (15) preferably has a cylindrical structure and the air inlet opening (13) is provided on the lateral surface of the outer casing(15) so that it provides vortex in the suction air, whereas the air outlet opening (14) is preferably positioned vertically on the upper surface of the outer casing(15). Said air inlet opening (13) opens to the first cyclonic separator housing (8) and is tangential to the lateral surface of the first cyclonic separator housing (8) in order to create a vortex.

Said first cyclonic separator housing (8) is placed in the outer casing(15), and is preferably of a cylindrical structure. As it is smaller in diameter than the diameter of the outer casing(15), a first dust receiving

chamber (11) is formed between the outer casing(15) and the first cyclonic separator housing (8). At least one window (16) is provided above the first cyclonic separator housing (8), almost at the same level as the air inlet opening (14), facing said opening (14), which opens to the first dust receiving and collection chamber (11) thus providing the passage of the coarser dust particles to the first dust receiving chamber (11) by means of the centrifugal force.

The second cyclonic separator housing (9) is placed coaxialy in the first cyclonic separator housing (8). Said second cyclonic separator housing (9) has a conical structure with a smaller diameter at the bottom to increase the air flow velocity. The diameter of the conical structure first decreases (converges) considerably and then this narrowing rate is reduced and thus a structure with two cascades is formed,

The outlet port of the second cyclonic housing (9) opens to the second dust receiving chamber (12) and is positioned slightly above the outer casing(15). An air-flow directing structure (17) is placed in the second dust receiving chamber (12), just below the outlet port of the second cyclonic housing (9), which cuts down the velocity of the medium-sized dust particles hitting against it, in order to let them be collected in the second dust receiving chamber (12) and which directs the air flow to the third cyclonic separator housing (10).

The third cyclonic separator housing (10) is so placed in the first cyclone housing (8) that it is aligned on the same axis as the first cyclone housing (8) and the air flow-directing structure (17). The inlet opening of the third cyclonic separator housing (10) is positioned at the same level as the air flow directing structure (17), at a level above the outlet opening of the second cyclonic separator housing (9). Said third cyclonic separator housing (10) opens to the air outlet (14) and consists of a conical portion

diverging from the inlet opening and a cylindrical portion coming after the conical portion. Said conical portion has a perforated structure consisting of one or more holes (18), that prevents the noise created due to the narrow crosssection and avoids the pressure drops.

When the vacuum cleaner is operated, the dust-laden air sucked-in through the cleaner head (5) is directed towards the cyclone unit (7). Air entrained tangentially into the inner wall of the first cyclonic separator housing (8) is subjected to centrifugal forces due to the cylindrical structure of the first cyclonic separator housing (8). The coarser particles in the air sucked in, are pushed towards the outer wall of the first cyclonic separator housing (8) by means of the said centrifugal forces and they pass through the window (16) under the effect of their own weights, to be collected in the first dust receiving chamber (11). The smaller dust particles swirl around in the first cyclonic separator housing (8) and reach the second cyclonic separator housing (9). Due to the conical structure that converges toward the bottom, of the second cyclonic separator housing (9), the velocity of the air flow is increased. The medium-sized particles are collected in the second dust receiving chamber (12), by means of the centrifugal force at the outlet of the second cyclonic separator housing (9) and of the air flow directing structure (17). Air, directed by the air flow directing structure (17), is elevated from the bottom of the second dust receiving chamber (12) and enters the third cyclone unit (10). In the third cyclonic separator housing (10), the pressure of the air increases as its speed decreases due to the conical structure of the portion that extends in a diverging manner from the inlet, and the fine dust particles contained in said housing fall down under the effect of the centrifugal force, they pass through the inlet opening of the third cyclonic separator housing (10) and are collected in the second dust receiving chamber (12). The purified air, freed of dust particles, leaves the cyclone unit (7) through the air outlet opening (14).

In another embodiment of the current invention, the cyclone unit (7) comprises a trap piece (19) that is placed within the first cyclonic separator housing (8), concentric with the third cyclonic separator housing (10) and wraps the third cyclonic separator housing (10). The form of the trap piece (19) is similar to the form of the third cyclonic separator housing (10). The trap piece (19) is composed of a cylindrical portion and a conical portion. The trap piece (19) lays between the top and bottom of the outer casing (15), and contacts the air flow directing structure (17).

The trap piece (19) comprises one or more than one openings (20) on the conical portion, for enabling the flow of air into the third cyclonic separator housing (10).

By using the cyclone unit (7), dust bags are no longer required in the vacuum cleaners and the drops in the suction efficiency occurring due to the fullness status of the dust bags are avoided.

CLAIMS

1. A vacuum cleaner comprising a cyclone unit (7) that includes an outer casing(15); an air inlet opening (13) located on the outer casing (15), whereby the sucked-in air enters; an air outlet (14); three cyclonic separator housings (8,9, and 10) to separate the dust borne in the sucked-in air, that are arranged in a telescopic manner, coaxially, in series wherein the air inlet opening (13) is provided on the lateral surface of the outer housing (15) so that it provides vortex in the suction air; characterized with a first cyclonic separator housing (8) of a preferably cylindrical structure placed in the outer casing(15), having a smaller diameter than the diameter of the outer casing(15); a second cylonic separator housing (9), placed coaxially in the first cyclonic separator housing (8) and having a conical structure with a smaller diameter at the bottom to increase the air flow velocity wherein its diameter first decreases (converges) considerably and then this narrowing rate is reduced and thus a structure with two cascades is formed; and a third cyclonic separator housing (10) so placed in the first cyclone housing (8) that it is aligned on the same axis as the first cyclone housing (8) and comprising a conical portion diverging from the inlet opening and a cylindrical portion coming after the conical portion.

2. A vacuum cleaner (6) as defined in Claim 1, characterized with the cyclone unit (7) comprising a first dust receiving chamber (11) located between the outer casing(15) and the first cyclonic separator housing (8) and at least one window (16) provided on the first cyclonic separator housing (8), almost at the same level as the air inlet opening (14), which opens to the first dust receiving and collection chamber (11) thus providing the passage of the coarser dust particles to the first dust receiving chamber (11) by means of the centrifugal force.

3. A vacuum cleaner (6) as defined in Claims 1 and 2, characterized with the cyclone unit (7) comprising a second dust receiving chamber (12) to which the outlet port of the second cyclonic housing (9) opens and an air flow directing structure (17) provided just below the air outlet opening of the second cyclonic housing (9), which cuts down the velocity of the medium sized dust particles hitting against it, in order to let them be collected in the second dust receiving chamber (12) and which directs the air flow to the third cyclonic separator housing (10).

4. A vacuum cleaner (6) as defined in Claims 1 to 3, characterized with the cyclone unit (7) comprising the third cyclonic separator housing (10) wherein, its inlet opening being positioned at the same level as the air flow directing structure (17), at a level above the outlet opening of the second cyclonic separator housing (9); that opens to the air outlet opening (14) and has a perforated structure consisting of one or more holes (18), that prevents the noise created due to the narrow cross section and avoids the pressure drops.

5. A vacuum cleaner (6) as defined in any one of the previous claims, characterized with the cyclone unit (7) comprising a trap piece (19) that is placed within the first cyclonic separator housing (8), concentric with the third cyclonic separator housing (10) and wraps the third cyclonic separator housing (10).

6. A vacuum cleaner (6) as defined in Claim 5, characterized with the cyclone unit (7) comprising the trap piece (19) that is composed of a cylindrical portion and a conical portion, that lays between the top and bottom of the outer casing (15), and contacts the air flow directing structure (17).

7. A vacuum cleaner (6) as defined in Claim 6, characterized with the cyclone unit (7) comprising the trap piece (19) that has one or more than one openings (20) on the conical portion, for enabling the flow of air into the third cyclonic separator housing (10).

FIGURE 1

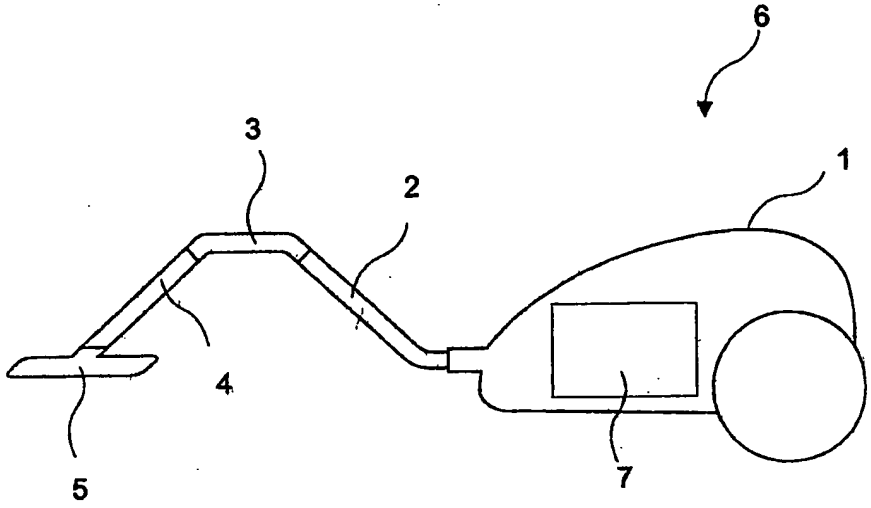


FIGURE 2

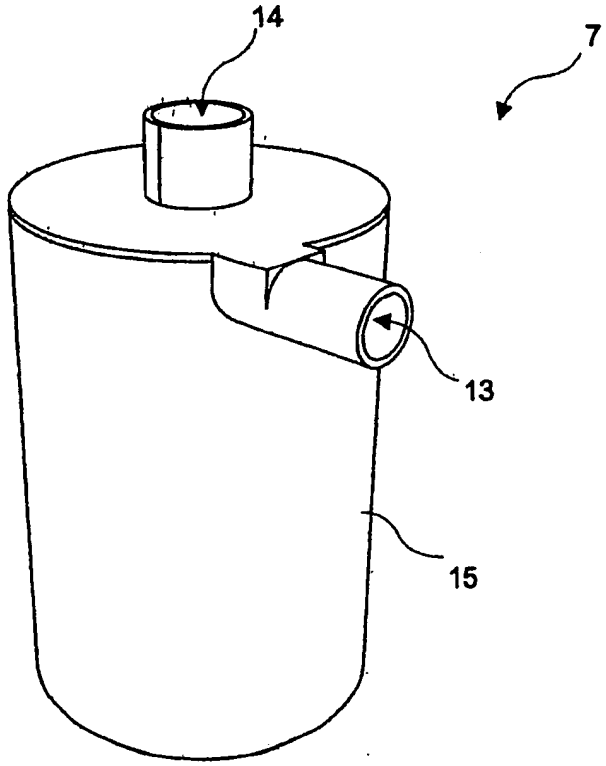


FIGURE 3

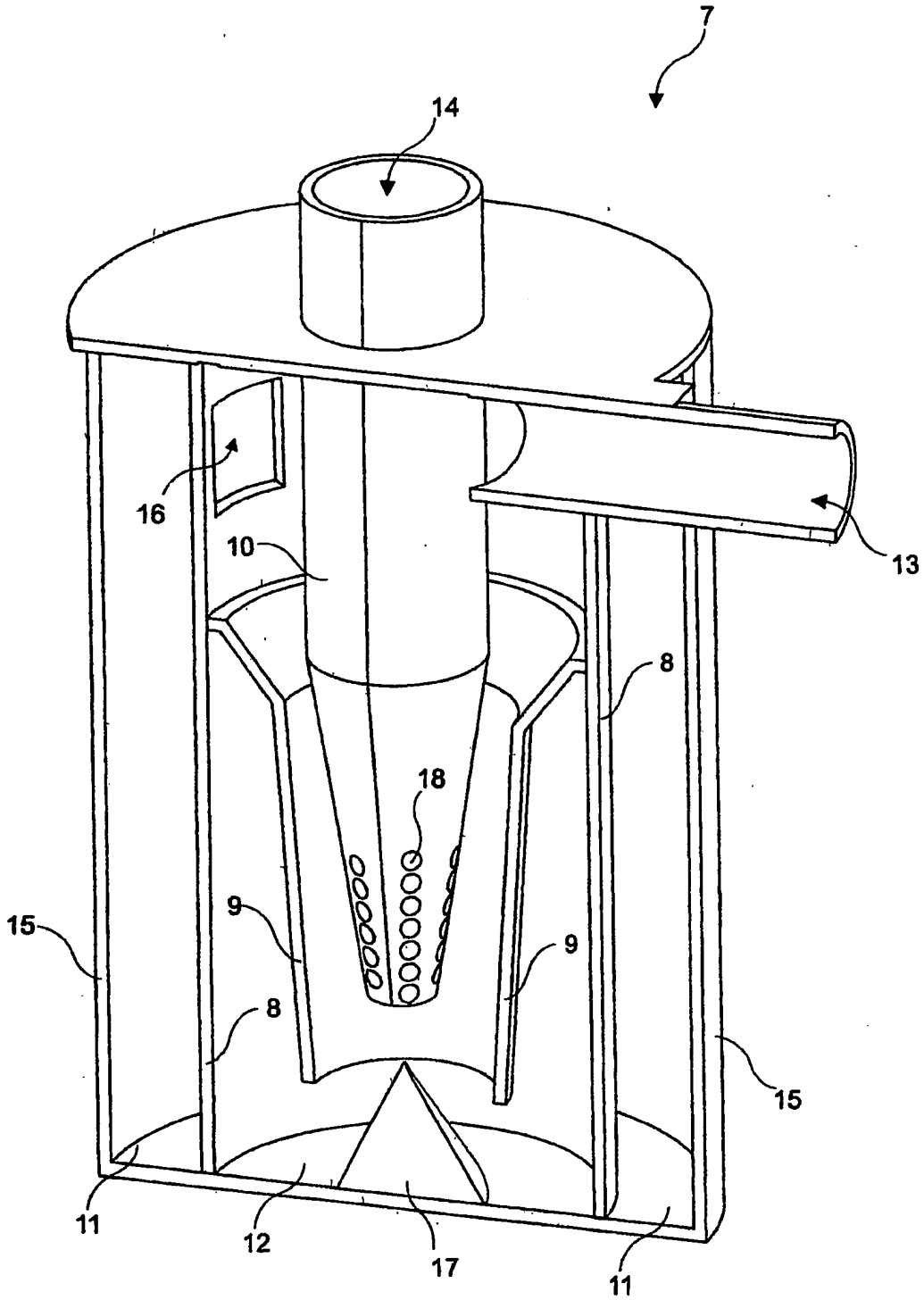


FIGURE 4

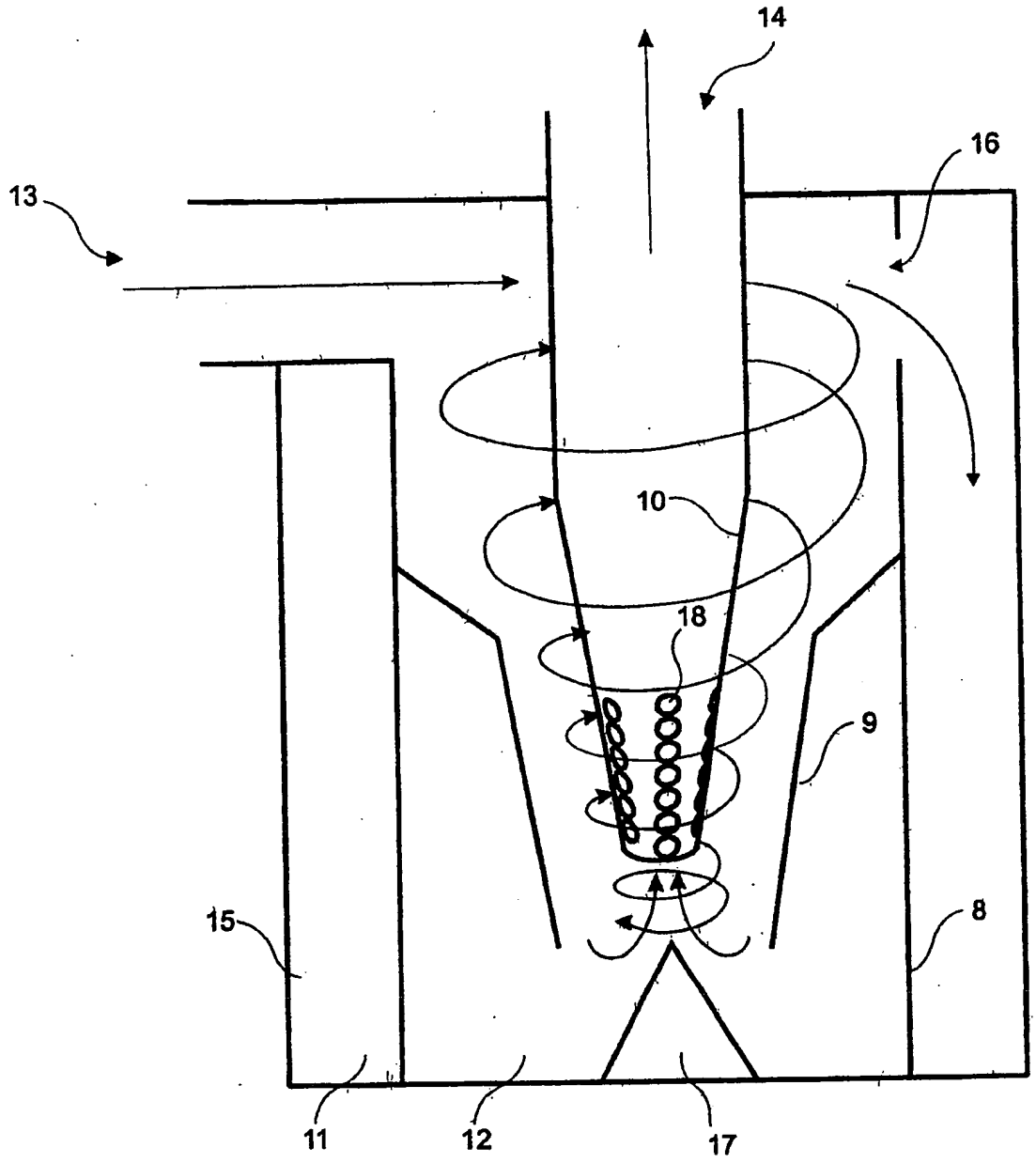
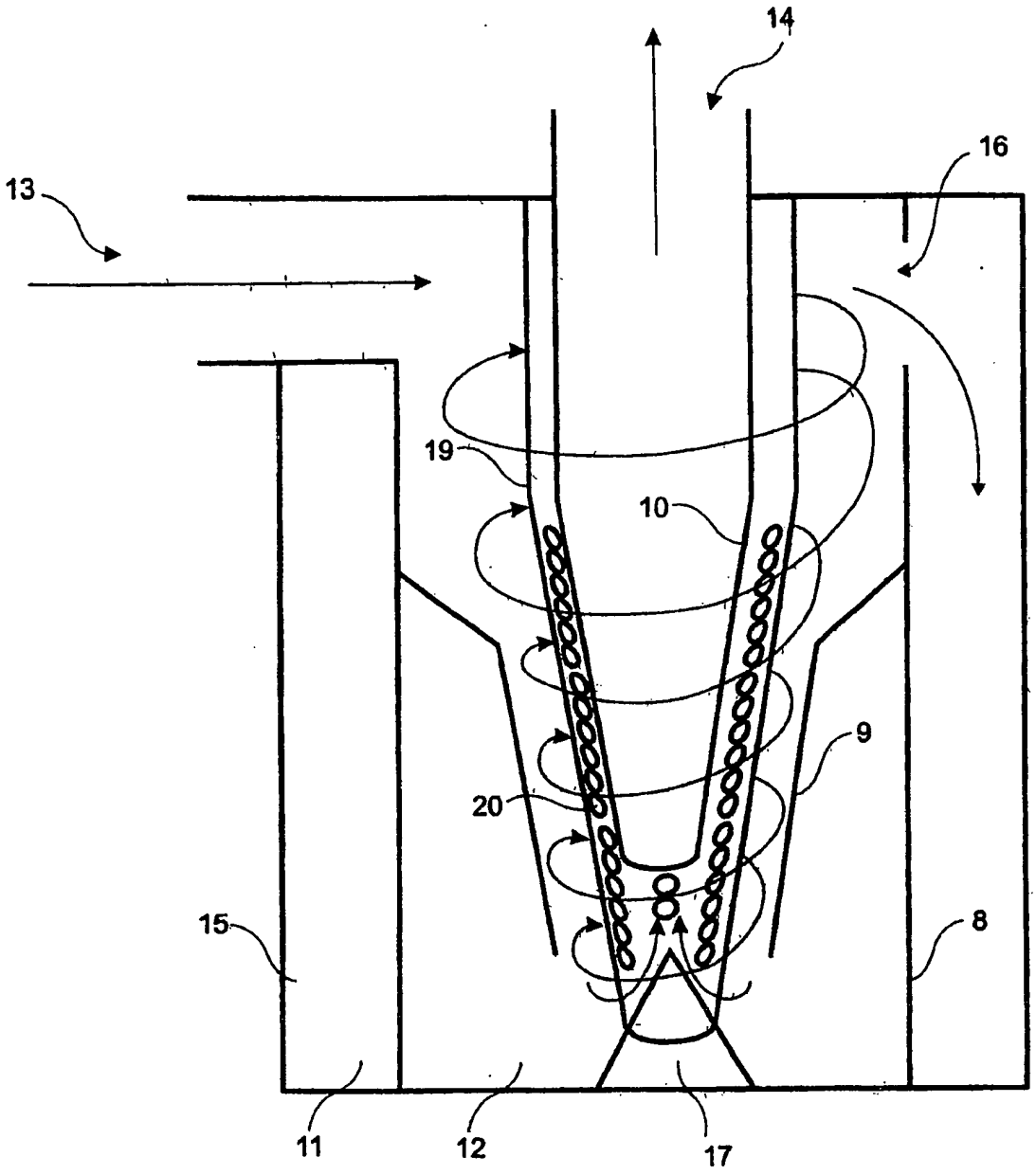


FIGURE 5



(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
17 April 2003 (17.04.2003)

PCT

(10) International Publication Number
WO 2003/030702 A3

(51) International Patent Classification[7]: A47L 9/16, B04C 5/08, 5/13

(21) International Application Number: PCT/TR2002/000064

(22) International Filing Date: 11 October 2002 (11.10.2002)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2001/02964 12 October 2001 (12.10.2001) TR
2002/02352 11 October 2002 (11.10.2002) TR

(71) Applicant *(for all designated States except US)*: **ARCELIK A.S.** [TR/TR]; E5 Ankara Asfalti Uzeri, Tuzla, 34950 Istanbul (TR).

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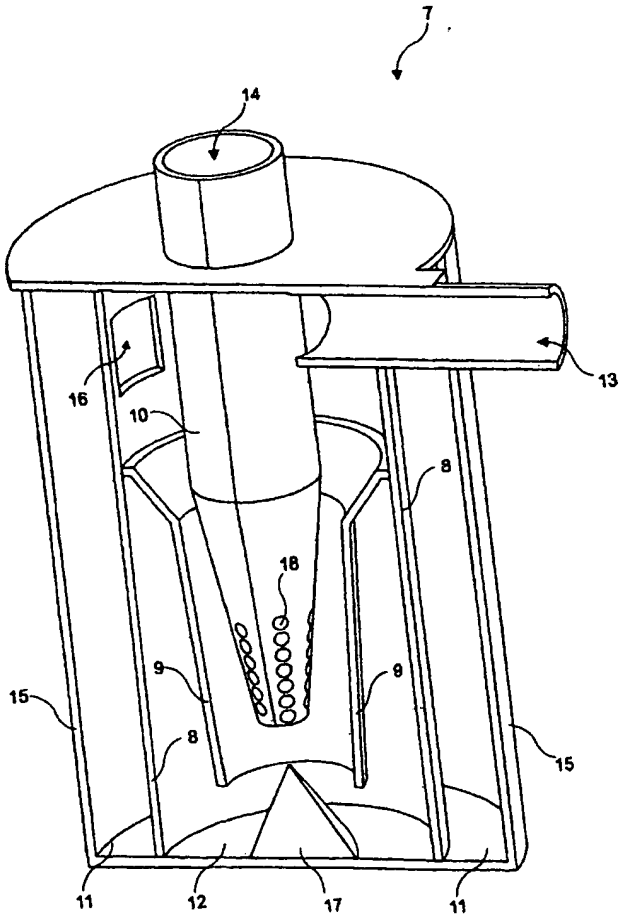

(57) Abstract: The vacuum cleaner comprises a cyclone unit (7) that separates and extracts the dust and dirt from the sucked-in dirt laden air. Said cyclone unit (7) comprises an outer casing (15); an air inlet opening (13) located on the outer casing (15), whereby the sucked-in air enters; an air outlet (14); three cyclonic separator housings (8,9, and 10) to separate the dust borne in the sucked-in air, that are arranged in a telescopic manner, coaxially in series; and chambers (11 and 12) for receiving and collecting the separated dust particles.

WO 2003/030702 A3

(84) **Designated States** *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report*

(88) **Date of publication of the international search report:**
4 March 2004

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A47L9/16 B04C5/08 B04C5/13

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A47L B04C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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	-/--	

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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4 March 2003	21/03/2003

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Lodato, A

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